

**To study the effects of parental voice on physiological status and feeding tolerance in preterm newborns admitted in NICU**

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**Citation this Article:** Dr. Divya Jyoti, Dr. Ashutosh Sharma, Dr. Sunita Koreti, Dr. Ajay Gaur, “To study the effects of parental voice on physiological status and feeding tolerance in preterm newborns admitted in NICU”, IJMSIR- May - 2022, Vol – 7, Issue - 3, P. No. 265 – 271.

**Type of Publication:** Original Research Article

**Conflicts of Interest:** Nil

**Abstract**

**Background:** While in utero, a foetus can hear and respond to maternal sounds as early as 26 weeks of gestation.<sup>1</sup> The foetus is stimulated by constant acoustic of mother’s heartbeat, voice, breathing and movements. When born prematurely the infant cannot experience the normal amount of exposure to these important sounds due to complex healthcare require for survival. In the NICU, preterm infants are often exposed to a great variety of temporally non-contingent auditory stimuli. By the last trimester of gestation fetuses respond to auditory stimulation, memories some characteristics of the mother’s voice and become familiar with the specific rhythmic organization of their mother’s language. The short-term outcome of maternal voice exposure include it improves physiological stability of preterm neonates.<sup>2</sup> The main potential outcomes that maternal sound alter in long term is neurodevelopment.

**Material and Methods:** Case control study was conducted in Gajra Raja Medical college Gwalior from

January 2020 to October 2021 to study the effect of parental voice on physiological status feeding tolerance pattern and duration of hospital stay. Medically stable preterm infants were included and exposed to voice recording of mother which was done by using Mobile voice recorder. Vital at the time of admission and during voice therapy was taken and Data was entered on SPSS software

**Results:** Mean heart rate before and during voice therapy in case group was 132.052±12.546 bpm and 130.126±11.056 bpm respectively. Mean saturation before and during voice therapy was 94.42±2.091% and 95.62±2.082% respectively. Among case group 13.8% of preterm new borns were having more than three episodes of feed intolerance and in control group 25.3% preterm new borns had more than 3 episodes of feed intolerance. Mean duration of hospital stay for case group was less as compared to control group.

**Conclusion:** Voice therapy has showed positive effect on physiological status, feeding tolerance, less episodes of critical events in case group.

**Keywords:** Preterm Parental Voice Feed intolerance, Vital.

### **Introduction**

While in utero, a foetus can hear and respond to maternal sounds as early as 26 weeks of gestation.<sup>1</sup> The foetus is stimulated by constant acoustic of mother's heartbeat, voice, breathing and movements. When born prematurely the infant cannot experience the normal amount of exposure to these important sounds due to complex healthcare require for survival. Their psycho-physiological state is no longer supported by the intrauterine environment maternal sleep-wake, hormonal and nutritional cycles, but by the NICU routines. The caregiving environment can affect infant's organization, and individualized care as well as interactive experiences is necessary to promote healthy development for preterm infants. In the NICU, preterm infants are often exposed to a great variety and density of temporally non-contingent auditory stimuli, sounds from the equipment, monitor alarms and conversations by the last trimester of gestation fetuses respond to auditory stimulation, memorize some characteristics of the mother's voice, and become familiar with the specific rhythmic organization of their mother's language. premature infants often experience extended stays in the neonatal intensive care unit as opposed to home with parents, The maternal voice in pattern of singing has suggested as a tool for alleviating stress, providing cost effective strategy to improve empathy and compassion without interfering routine work in NICU.<sup>2</sup>

Recorded maternal or paternal sound interventions have been found to be implemented safely and feasibly n the

NICU.<sup>3</sup>The implementation of this intervention did not interfere with routine care for these medically fragile neo nates music has been used for healing and stimulating emotions for centuries, music stimulation has been shown to provide significant benefits to preterm infants. Maternal sound interventions can be implanted in a different way. The sound can be delivered via playing a recording or live from mother in person. Live maternal voice stimulation cannot always possible, as mother may not be available to be at bedside in the NICU during hospitalization of new born, a possible solution is the use of technology to record maternal sounds and play them in incubators during mother's absence.<sup>4</sup>

The short-term outcome of maternal voice exposure include it improves physiological stability of preterm neonates. Physiological outcomes include heart rate, respiratory rate, oxygen saturation, temperature, skin color<sup>5</sup>.Another outcome that maternal sound interventions can alter is nutrition. Preterm neonates more likely to have feeding difficulties than term newborns, due to immature suck-swallow-breath coordination and immature feeding skills.<sup>6</sup> and difficulty establishing a tolerance to oral feeding s in first two weeks.

The lack of sensory stimulation also seen in preterm newborns admitted in NICU which is necessary for auditory brain development. Neonates hospitalized in NICU's were found to have decreased brain maturation and lower language and motor skills at 2 years of age.<sup>7</sup> Exposure of recorded maternal sound interventions in incubators may decrease the sensorial deprivation of pre term newborns.

### **Material and methods**

This Case control study was conducted in Gajra medical college Gwalior to study the effect of parental voice on

physiological status duration of NICU stay and feeding tolerance in preterm newborns admitted in NICU. Study was conducted from January 2020 to October 2021 after obtaining Institutional ethical committee clearance Medically stable pre term newborns born between 28 weeks to 32 weeks were selected 100 newborns were selected in case and control group and extremely preterm late preterm medically unstable newborns were excluded Tools used were Sound meter apparatus Saturation probe and Mobil phone voice recorder and medical records of critical events from case sheets was taken voice recording was done by using mobile voice recorder, and sound level of voice of mother/father was measured using sound meter apparatus. Before exposing the voice to control group, SNCU auditory levels have been maintained between 50dB to 70 dB. Demographic data of preterm newborns were taken. Weight at the time of admission Vitals at the time of admission (Heart rate, SPO<sub>2</sub>, Respiratory rate Temperature and CRT)

Voice therapy has been given to cases group, on non-consecutive days on day 2, day4, day6, day 8, day 10, day 12 for the duration of 10 minutes 12 hours a part. Heart rate, saturation has monitored during the voice exposure and before voice exposure. Feeding tolerance, critical events like GI bleed, hypoxia, hypoglycemia, hypothermia, and hyperthermia have been taken and compared between cases and controls. The total duration of hospital stay and duration of shifting to mother side has been compared between cases and controls. Data was entered into Microsoft excel software then export to SPSS 22.0 software for analysis

## Results

This case control study was conducted in Gajra raja medical college in Department of Pediatrics this study shows that mean heart rate and SPO<sub>2</sub> before voice

exposure was more then during voice exposure this shows maternal voice has significant impact on Heart rate and SPO<sub>2</sub>(Fig 2 and 3)

## Episodes of critical events

In this study critical events observed are GI bleed, hypoglycemia, hypothermia, hyperthermia, hypoxia and apnea.6(6%) of preterm newborns from case group had GI bleed, and 8(8%) of preterm newborns from control group had GI bleed during study period. Out of 100 preterm newborns of case group,10(10%) were undergone hypoglycemic state, and 12(12%) of preterm newborns of control group were undergone hypoglycemic state.

## Episodes of feed intolerance

One episode of feed intolerance was seen in 22(22%) of preterm newborns in cases group, while in control group one episode of feed intolerance had seen were 8(8%). Two episodes of feed intolerance was seen in 28(28%) of preterm newborns in cases group, and among control group was 14(14%) Three episodes of feed intolerance were seen in 7(7%) of preterm newborns in cases group, and among control group was 26(26%).

Fig 3 shows more number of feed intolerance was observed in control group as less than 3 episodes of feed intolerance was greater in case group, and more than 3 episodes of feed intolerance was greater in control group.

## Mean duration of hospital stays

Mean duration of hospital stay of interventional and non-interventional groups. Mean duration of hospital stay is less in interventional group (13.21±1.09), compared to non-interventional group (15.24±2.83), p value is 0.04 which is significantly correlated.

## Final outcome

90 % of preterm newborns from case group were discharged, and 6% were died during interventional

process, 3% newborns were discontinued due to various reasons. Among control group 87.9% preterm newborns were discharged and 9% newborns were died during the stay in SNCU, 4% of newborns were discontinued however it was not statistically insignificant

### Discussion

The present study “To study the effects of parental voice on physiological status and feeding tolerance of preterm newborns admitted in NICU” was done in department of Pediatrics, Gajra Raja Medical College, Gwalior. It was a case control study. 200 very preterm newborns have been enrolled for the study, 100 preterm newborns were selected as cases and 100 preterm newborns were selected as control by randomized selection. This study results showed that exposure to parental voice has significant effect on decreased heart rate, decreased feed intolerance, early achieving of oral feeds and less duration of hospital stay in case group. Critical events which were observed during this study were GI bleed, hypoglycemia, temperature instability, and hypoxia. 6(6%) preterm newborns from case group were had GI bleed, and 8(8%) preterm newborns from control group had GI bleed. 10(10%) preterm newborns of case group undergone hypoglycemic state, 12 (12%) preterm newborns of control group undergone hypoglycemic state. Out of all critical events majority of study group had hypoglycemia during study period. Aye new Engida Yismaw et al.<sup>8</sup> study results reveal that, 21% of study population had hypoglycemia. Temperature instability has observed in 9.5% of study population, 3(3%) preterm newborns from case group were had hypothermia and 4(4%) preterm newborns from control group were had hypothermia. Hyperthermia has observed in 12(6%) preterm newborns of study population. 5% of them from case group and 7% of them from control group. Aynew

Engida Yismaw et al.<sup>8</sup> study population had hyperthermia in 30% of preterm newborns, and hypothermia in 2.9% of preterm newborns.

In current study, the episodes of feed intolerance was less in case group. 12% of preterm newborns from case group had no episodes of feed intolerance, whereas 16% of preterm newborns from control group had 5 episodes of feed intolerance, whereas only 5% of preterm newborns from case group had 5 episodes of feed intolerance. p value was 0.002. Jayne M. Standley et al.<sup>9</sup> has concluded that feeding rate in interventional group was 2.9CC/minute after intervention, before intervention that was 2.2CC/minute. Joanne Loewy et al.<sup>10</sup> study results showed that feeding rate in intervention group more than control group after music therapy. Oral feeding rate before intervention was 0.6ml/minute in both interventional and control group.

The base line heart rate was greater than during voice therapy in case group. On day 2, baseline heart rate was  $124.26 \pm 12.474$ , and during voice therapy was  $121.32 \pm 13.561$ . On day 4 baseline heart rate was  $123.77 \pm 14.205$  and during voice therapy was  $118.58 \pm 18.455$ . On day 6 baseline heart rate was  $122.01 \pm 14.475$ , during voice therapy was  $115.32 \pm 12.513$ . During voice exposure the heart rate was lesser than basal heart rate. Similar results were found in other studies, Manuel Filipa et al.<sup>11</sup> study revealed that baseline heart rate in experimental group was 149.7 and during music therapy heart rate was 146.3. Hye Jung Lee et al.<sup>12</sup> study results showed that heart rate during voice therapy was significantly low with p value  $< 0.001$ . O Picciolini et al.<sup>13</sup> study results concluded that mean heart at the end of music therapy was less than basal heart rate. Mean basal heart rate was  $150.5 \pm 14.3$ , and during intervention was  $149 \pm 14.1$ . Anat Shapsa et al.<sup>14</sup> study results were also revealed that mean heart rate

before therapy was  $150\pm 3.3$ , during therapy was  $144\pm 3.7$ , after therapy was  $127\pm 6.5$ . In this study there was no significant changes in oxygen saturation levels before voice exposure and during voice exposure. Mean saturation level before voice therapy on day 2 was  $94.74\pm 3.148$ , and during voice exposure was  $95.75\pm 3.031$ . On day 4 mean saturation level before voice exposure was  $95.03\pm 2.696$ , during voice exposure was  $95.84\pm 0.249$ . On day 6 mean saturation before voice exposure  $95.14\pm 2.935$ , during voice exposure was  $96.43\pm 2.679$ . On day 8 mean oxygen saturation before voice  $95.85\pm 2.683$ , during voice exposure  $96.85\pm 2.640$ . On day 10, mean oxygen saturation before voice exposure  $95.90\pm 2.902$ , during voice exposure was  $97.32\pm 2.043$ . Similar results were found in other studies. Manuel Filipa et al.<sup>13</sup> study results has concluded that mean saturation levels before music therapy 95.7%, during music therapy it was 96.4%. With p value  $< 0.033$ . Hyejung Lee et al.<sup>12</sup> study revealed that mean oxygen saturation level shows significant result with p value  $< 0.003$ . O. Picciolini et al.<sup>4</sup> study results revealed that mean oxygen levels before music therapy was  $0.97\pm 0.05\%$ , during voice therapy was  $0.97\pm 0.06\%$  with insignificant p value  $< 0.50$ . Anat Spasha et al.<sup>14</sup> study revealed that mean oxygen saturation before therapy was  $91\pm 6.8\%$ , after therapy was  $94\pm 4.5\%$ .

In current study preterm newborn in case group has mean duration of shifting to oral feeds was  $9.53\pm 2.67$ . and in control group was  $10.98\pm 2.40$  with p value  $< 0.01$ . maternal voice exposure has shown positive effect on achieving early oral feeds. AynurYidliz et al.<sup>15</sup> study on effect of lullabies on their transition period for total oral feeding revealed that mean duration of transition period to total oral feeding is  $280.30\pm 174.89$  hours in control group, and of lullaby group was  $243.03\pm 123.34$  hours.

Music therapy has positive effect on achieve total oral feedings. Joane Loewy et al.<sup>10</sup> study on the effect of music therapy on vital signs revealed that there was no significant change in number of oral feeds per day in case and control group. Charlene Krueger et al.<sup>16</sup> study results has showed that mean duration to achieve oral feeds in experimental group was  $28.9\pm 13.6$  days. In current study Mean duration of hospital stay of case group of this study was  $13.21\pm 1.09$  days, and of control group was  $15.24\pm 2.83$  days. O. Picciolini et al study.<sup>4</sup> concluded that mean duration of hospital stay of intervention group was  $55.6\pm 19.8$  days, and for control group was  $54.6\pm 15.8$  days. Which was lesser than interventional group AynurYidliz et al.<sup>15</sup> study results revealed that duration of hospital stay of control group was  $522.03\pm 269.3$  hours and of lullaby group was  $496.30\pm 223.66$ . J.M. Standley et al.<sup>9</sup> study results revealed that average days of hospital stay after achieving full oral feeds of control group was 10.25 days, and in intervention group was 6.63 days. Joanne Loewy et al.<sup>10</sup> study group, has 41 days of mean duration of hospital stay. Control group had 50 days of mean duration of hospital stay.

### Conclusion

From this study, the voice therapy has showed positive effect on physiological status, feeding tolerance, less episodes of critical events in case group. The mean duration of shifting to katori feed and mean duration of hospital stay was less in case group. This concludes that exposure to parental voice can be beneficial for preterm newborns in terms of hospital stay and physiological stability.

### Recommendations

The auditory levels of NICU should be maintained for neuro developmental outcome and sleep status. The ideal auditory levels to be maintained in NICU are 55dB-



75dB. Along with KMC, voice therapy to preterm newborns should be a part of preterm newborn's management. Mother NICU should be an integral part of NICU. M-NICU are NICUS, where mother resides inside NICU having her bed beside radiant warmer. She can watch for feed tolerance, sleep status, hygiene for the fragile preterm, newborn. The early exposure to maternal voice can improve language abilities in preterm newborns.

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**Legend Figures and Tables**

Fig 1: Algorithm of methodology

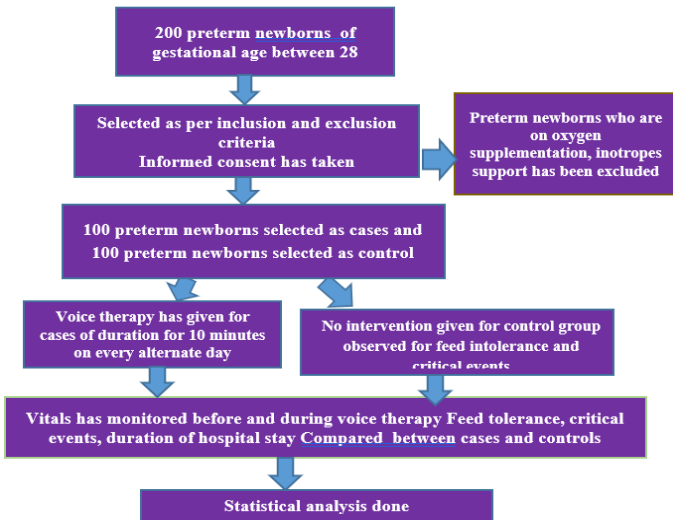


Fig 2: Comparison of mean heart rate before voice therapy and d`5uring voice therapy

Testing Days	Mean HR (before voice exposure)	Mean HR (during voice exposure)	T value	P value
Day 2	124.26±12.474	121.32±13.561	2.45	0.021
Day 4	123.77±14.205	118.58±18.455	2.629	0.010 00
Day 6	122.01±14.475	115.32±12.513	4.870	0.000
Day 8	119.18±13.210	111.57±12.380	2.630	0.011
Day 10	115.19±12.390	110.06±14.507	2.673	0.012
Day 12	115.37±22.301	114.67±19.421	3.860	0.613

Fig 3: Comparison of Spo2, before and during voice therapy

Testing days	Mean Spo2 (before voice exposure)	Mean Spo2 (during voice exposure)	T value	P value
Day 2	94.74±3.148	95.75±3.031	-2.544	0.013
Day 4	95.03±2.696	95.84±2.949	-2.592	0.034
Day 6	95.14±2.935	96.43±2.679	-2.161	0.009
Day 8	95.85±2.683	96.85±2.460	-2.417	0.01

Day 10	95.90±2.902	97.32±2.043	-3.498	0.002
Day 12	95.65±3.786	96.33±2.517	0.311	0.000

Fig 4: Episodes of feed intolerance

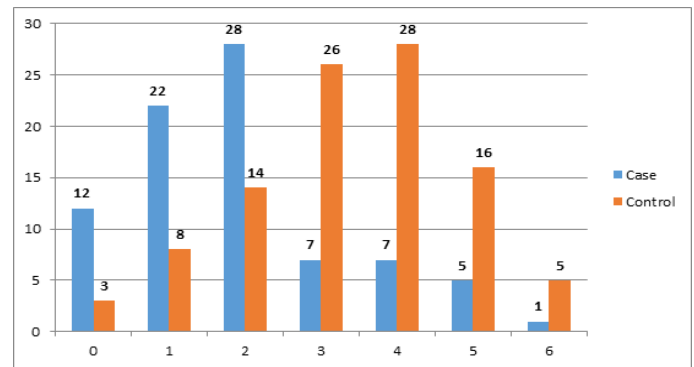


Fig 5: Final outcome

Variables	Case	Control	Total	Chi square	P value
Certified	6(6%)	9(9%)	15(7.5%)	1.551	0.671
Discharged	91(91%)	87(87%)	176(88)		
Discontinued	3(3%)	6(6%)	9(4.5%)		